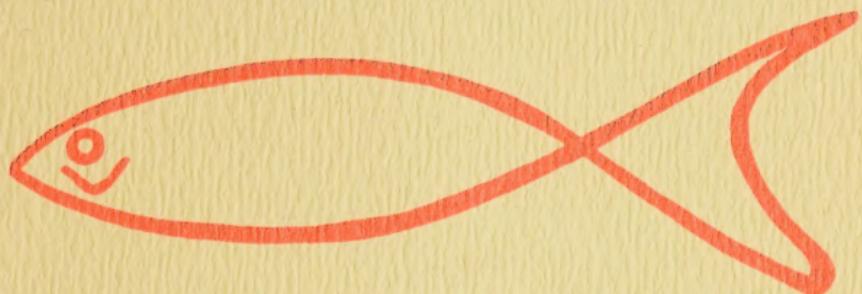


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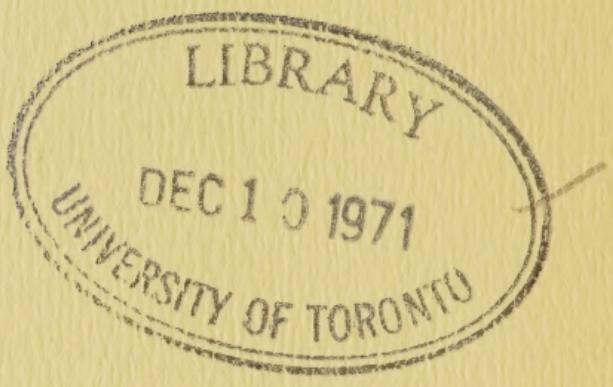
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... ABOUT **MERCURY IN FISH**



Ontario Department of Lands and Forests



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.... ABOUT MERCURY IN FISH



DEPARTMENT OF LANDS AND FORESTS
HON. RENE BRUNELLE
Minister

W. Q. MACNEE
Deputy Minister

What is mercury?

Mercury (Hg) is one of the heavy metals. It can occur in many chemical compounds, but cannot be decomposed. Mercury is a liquid at room temperature, but when combined with other elements, the resulting compound is usually a solid. Mercury and many of its solid compounds are nearly insoluble in water. If introduced into lakes or streams, they tend to sink to the bottom.



Is mercury found in nature?

Mercury is not generally found naturally in the elemental (liquid) form. It is found in small but varying amounts in rock and soil, usually combined with sulphur. Trace amounts occur naturally in plants and animals, and therefore, in food.

If trace amounts of mercury are found naturally in plants and animals, why is there so much concern about mercury in fish?

During the past year fish in some Ontario waters have been found to contain mercury in concentrations exceeding that which is acceptable for fish. Almost all of the mercury in fish and other animals exists in a highly toxic form known as methyl mercury. It is readily absorbed into the body when contaminated fish are eaten. Because methyl mercury is excreted very slowly, repeated eating of fish (or other food) containing more than the acceptable concentration of mercury can result in harmful mercury accumulation in the body. If sufficient quantities are eaten, nervous disorders and even death can result.

How are mercury concentrations in fish measured, and how are the results reported?

Measuring mercury is a complicated laboratory procedure that can be done only with specialized

equipment and trained analysts. The results of a mercury analysis are reported in parts per million (ppm). One ppm indicates one part of mercury in one million parts of fresh (water not removed) fish flesh, and is equivalent to one ounce of mercury in approximately 60,000 pounds of fish.

What is the maximum acceptable concentration of mercury in fish for human consumption, and how was this standard chosen?

The legally accepted level in Canada for mercury in edible parts of fish is set at $\frac{1}{2}$ ppm by the Federal Food and Drug Directorate. This standard was chosen on the basis of animal toxicity experiments and studies of humans poisoned by mercury from contaminated fish and shellfish in Japan. It contains a safety factor to protect individuals who are heavy fish eaters or who may be unduly susceptible to mercury poisoning.

Is the $\frac{1}{2}$ ppm mercury level used worldwide?

No, several countries including the U.S.A. have accepted this standard, but it is not universal. In Sweden, only fish containing less than $\frac{1}{5}$ ppm are considered suitable for unlimited human consumption, with the recommendation that fish in the range $\frac{1}{5}$ - $\frac{1}{2}$ ppm not be eaten more frequently than once per week. Average fish consumption in Sweden, however, is roughly 2 to 3 times greater than in Canada.

How dangerous is the consumption of fish with more than $\frac{1}{2}$ ppm of mercury?

This would depend on the frequency of fish consumption, the amount of fish eaten, and the mercury concentration in the fish consumed. In addition, there is considerable variability among individuals in susceptibility to mercury poisoning. No danger is likely with occasional (once per week) consumption of fish containing $\frac{1}{2}$ - $\frac{1}{2}$ ppm,

with the exception of pregnant women. The human fetus appears to be more susceptible to methyl mercury than the mother. Women of child-bearing age should probably not consume any fish containing more than ½ ppm mercury.



What are the symptoms of chronic mercury poisoning?

Most of the symptoms are related to changes in the nervous system. Symptoms include loss of peripheral (tunnel) vision, loss of motor coordination and resultant inability to walk, grasp objects, coordinate body movements, etc. Ultimately coma and death can result.

Is mercury toxic to fish and other aquatic life?

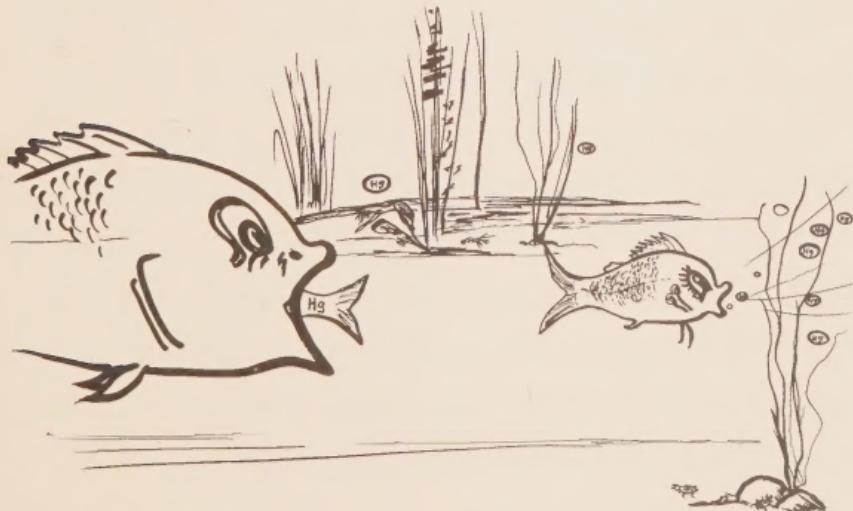
Certain mercury compounds are highly toxic to fish and lower aquatic animals when dissolved in water. However, fish kills due to mercury are not known to have occurred in Ontario. Mercury deposits in lake and river sediments from industries yield concentrations in water that are extremely low (near or below the minimum limit of detection). These minute concentrations are sufficient to cause accumulation of mercury in fish flesh, but are probably too low to be toxic to fish. Adverse effects on fish of mercury stored in the flesh are possible, but these effects, if they exist, have not been detected.

How much mercury is found in fish from Ontario waters?

In Ontario waters where there are no known local sources of mercury from human activities in the drainage system, most fish contain less than 1/2 ppm of mercury. In waters where there is such a known local mercury source, pike, pickerel and bass often contain 2 or 3 and up to 15 ppm. About 40 waters lacking known local sources of mercury from human activities have been found to contain some species of fish averaging approximately 1/2-1 ppm mercury. The reason for these apparently elevated mercury concentrations is unknown at this time. In all waters there is considerable variation in mercury concentration among and within various fish species. Some species, such as whitefish and bullheads, are often low in mercury even in waters where mercury concentrations are high in other species.

How do fish become contaminated with mercury?

Fish take in mercury through the skin and gills, as well as in their food. Various types of mercury compounds, both industrial and natural geological compounds, are nearly insoluble in water. These compounds settle on the river or lake bottom, and are converted by bacteria in the bottom sediments to methyl mercury (Answer No. 3). Methyl mercury is soluble in water and enters fish and other aquatic organisms which are consumed by fish.



Do animals other than fish accumulate excess mercury?

Yes, birds have been found in several places in Canada with high levels of mercury thought to be caused by consumption of seed-grain treated with a mercury fungicide. Very limited testing of other aquatic life (ducks, frogs, lower animals) has given indication of some elevated mercury levels, but to date the contamination does not seem to be as widespread as in fish.



Has mercury poisoning been documented in Ontario or other parts of the world?

Symptoms of mercury poisoning due to eating contaminated fish have not been diagnosed in Ontario or other parts of Canada. Elevated blood and hair levels of mercury have been noted in some Ontario residents who had eaten fish with more than $\frac{1}{2}$ ppm mercury content, but even in these individuals, blood and hair levels were well below those found in persons with symptoms of mercury poisoning. In two outbreaks of poisoning in Japan some years ago, about 150 persons became ill from eating mercury contaminated fish and shellfish; of these, over 40 died. A few other mercury poisoning incidents have been noted, the most recent being in New Mexico, where a family consumed pork which had been fed grain treated with mercury fungicide.

Is it safe to drink from a lake or stream known to contain mercury?

As far as mercury is concerned, the water is safe to drink.

Does cooking alter the mercury content of fish?

No, not to any significant degree.



What Ontario waters contain mercury contaminated fish?

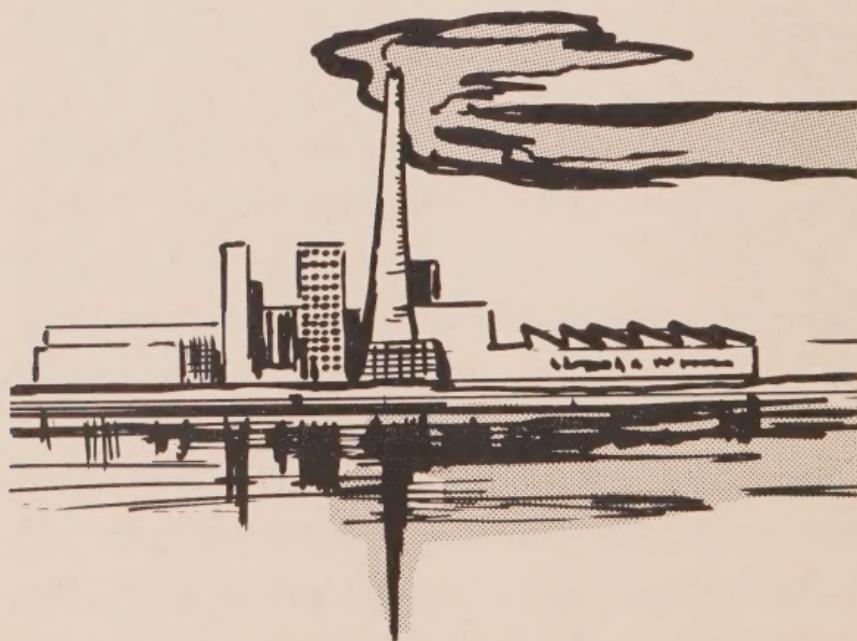
Several waters scattered over the province contain species of fish with mercury concentrations well in excess of $\frac{1}{2}$ ppm. These problem areas, all associated with mercury discharges from chlorine-alkali plants or pulp and paper mills are: portions of the English-Wabigoon-Winnipeg River system, St. Clair River, Lake St. Clair, Detroit River, eastern Lake Ontario and the St. Lawrence River, and the Ottawa River downstream from Ottawa.

In addition to these waters about 40 lakes have been found containing some fish of some species which are above the $\frac{1}{2}$ ppm level (mostly $\frac{1}{2}$ -1 ppm). In these waters, no local sources of mercury from human activities are known; mercury deposits in watersheds or atmospheric fallout are possible sources.

What are the major uses of mercury, and which uses are thought to be important in causing elevated mercury concentrations in fish?

Uses of mercury include: production of chlorine and alkali, electrical instruments production, pulp and paper processing, seed-grain treatment, pest control in fruit and vegetables, lawn treatment, paint manufacturing, and pharmaceutical and dental preparations. Other chemicals have replaced mercury compounds for some of these industries. Only some chlorine-alkali plants and pulp and paper mills were important sources of mercury in fish in Ontario. Substitute chemicals have completely replaced mercury compounds in the pulp and paper industry. Mercury losses from chlorine-alkali plants have been greatly reduced since May 1970.

Considerable but unknown amounts of mercury are released to the atmosphere through burning of coal, oil and waste materials. To what extent the fallout from this burning of fuels and wastes has contributed to the mercury content of fish is completely unknown at present.



How widespread is the mercury problem?

The problem is actually worldwide, with Japan, the U.S., Sweden and other countries being affected. Provinces other than Ontario also have elevated mercury concentrations in fish, although Ontario and Manitoba have probably received the most publicity concerning the mercury content of fish.

What is the Ontario Government doing to solve the mercury problem?

Lands and Forests has been collecting fish for mercury analysis from all areas of the province. Major waters with mercury contaminated fish have now been identified. Commercial fisheries on these waters have been closed and sport fishermen have been warned not to eat their catches. Investigations to gain further understanding of the mercury problem are underway.

The following are activities of the Ontario Water Resources Commission: study of patterns of mercury deposition in lake and river bottoms and methods of accumulation of mercury by aquatic life; evaluation of possible methods of deactivating or removing mercury sediment deposits and their safe disposal; enforcing limitations on the discharge of mercury compounds into waters. The O.W.R.C. performs most of the mercury analysis on fish collected by Lands and Forests. The Canada Center for Inland Waters has undertaken basic research concerning aquatic mercury compounds. The Federal Department of Fisheries and Forestry tests commercial fish shipments. Those that exceed the $\frac{1}{2}$ ppm mercury level are destroyed. The Ontario Department of Health is measuring the mercury content in hair and blood samples from persons living in the vicinity of lakes with highly contaminated fish.

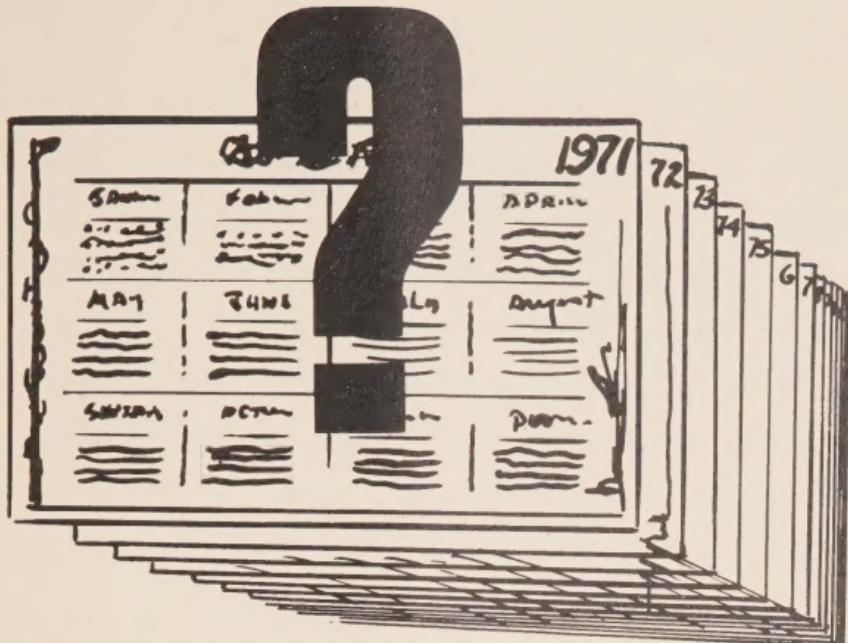
Why has the sport fishery not been closed on waters with fish having a high mercury content, and why are commercial fisheries still operating on waters with slightly elevated mercury levels in fish?

Although sport fisheries in mercury affected waters have remained open to allow continued recreational use, fishermen have been warned not to eat their catches from these waters. On waters with slightly elevated levels in fish, those to be offered for sale are sampled and tested. Catches of fish above the $\frac{1}{2}$ ppm mercury level are destroyed, but much of the commercial catch is below the $\frac{1}{2}$ ppm mercury standard, and safe for human consumption.

Has the mercury problem had an adverse economic impact? If so, what has been done to help those affected?

Commercial fishermen have been required to cease operations on waters containing mercury contaminated fish. On other waters where the mercury problem is not as serious, a portion of the commercial catch has had to be destroyed. Resort owners on waters having fish with mercury concentrations above the acceptable level reported loss of business. Some government assistance is being made available to resort owners. Joint Provincial-Federal loans and loans administered by the Ontario Development Corporation are available to commercial fishermen.





How long is the mercury problem expected to last?

The answer to this question is not yet known, but some background information may be helpful. Trace amounts of mercury are a natural part of the environment. While mercury compounds can be transformed and transported, they cannot be destroyed. It is unlikely that anything can be done about the levels of mercury in fish from waters where there are no known local human mercury sources. In waters having received industrial discharges of mercury, although these discharges have been greatly reduced, the mercury previously deposited is a continuing source of mercury in fish.

The Ontario Water Resources Commission is studying the feasibility of dredging mercury deposits from lake and river bottoms. Other methods such as physically covering mercury deposits or chemically deactivating them have been proposed, but it is not yet known if any of these might be successfully used. Unless some method of stopping the movement of mercury out of bottom sediments is developed, the mercury problem is likely to be with us for years to come.

Concluding Statement

Because the mercury problem is relatively new, a great deal of information is lacking that would be useful in answering some of the questions raised in this booklet. The answers given here make use of the most recent information available, but it is probable that some answers may require modification as the results of new studies become available.

Four departments of the Ontario Government and at least three departments of the Canadian Federal Government are spending considerable time and money to ensure that fish offered for commercial sale in Canada are safe with respect to mercury content. Every effort is being made to see that sport fishermen are supplied with up to date information concerning the safety of a favourite activity — eating their angling catch.

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